Appendix AA
Central Treatment Plant Discharge Requirements Technical Memorandum for the Bunker Hill Superfund Site

Central Treatment Plant (CTP) Discharge Requirements Technical Memorandum

February 12, 2015

Bunker Hill Superfund Site

Prepared by:

U.S. Environmental Protection Agency Region 10

In conjunction with:

CH2M Hill

I. Introduction

A. Purpose

The purpose of this memo is to establish surface water quality discharge requirements consistent with the substantive requirements of the National Pollution Discharge Elimination System (NPDES) permit program and remedies outlined in EPA's decision documents for the Central Treatment Plant (CTP), which operates and discharges on the Bunker Hill Superfund Site. The CTP currently operates to meet the discharge limits that were established in the NPDES permit that became effective in 1986 (Permit No. ID 000007-8). The permit was issued to the Bunker Hill Mining Company prior to EPA taking over operation of the facility in 1994.

B. CTP background

CTP History

The CTP was built by the Bunker Hill Mining Company in 1974 to treat acid mine drainage (AMD) from the Bunker Hill Mine. Ownership of the mine and surface facilities passed through a number of companies during the more than one hundred years of the area's mining and mineral processing history. In November, 1994, the federal and state governments assumed operation of the CTP when the owner went bankrupt. The New Bunker Mining Corporation (NBHMC) acquired the mine, mineral rights, and land above the mine, but not the CTP, during the bankruptcy. The CTP operated under the direction of EPA from November 1994 to February 1996 using money from a trust fund established in the bankruptcy. Since February 1996, the ongoing treatment of AMD and sludge disposal has been conducted and funded by the federal and state governments.

2001 Mine Water RODA – December 2001

EPA's 2001 Bunker Hill Operable Unit 2 Record of Decision Amendment (RODA) commonly referred to as Mine Water ROD (Section 7.1.5) outlines the selected remedial alternative for AMD treatment and calls for two phases for upgrading the CTP. Phase 1 addresses upgrades to most cost-effectively meet discharge requirements, minimize sludge volume, and maximize system reliability. It includes, but is not limited to, installation of tri-media filters and a backup power system, rehabilitation of existing equipment, improvements and additions to the lime feed and polymer makeup systems, and replacement of the existing antiquated and mostly inoperable control system with a modern computer based process control and operator interface system. Some, but not all, of the phase 1 upgrades (e.g. the automated control system, lime storage and feed system) were completed in 2005. Phase 2 upgrades would be implemented only if the CTP capacity needs exceeded 2500 gpm. The design flow rate in the 2001 Mine Water ROD was based on the Bunker Hill Mine being the primary source of waters for treatment.

The 2001 Mine Water ROD identifies key Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) guidance. The key ARARs identified for establishing acceptable limits of metals in discharge from the CTP include the Idaho Water Quality Standards and the National Recommended Water Quality Criteria for the contaminants of concern and the NPDES regulations. The substantive requirements for NPDES include discharge limits and monitoring requirements.

2012 Upper Basin IRODA

EPA amended existing selected remedies for Operable Units (OU) 1 and 2, and the Upper Basin portions of OU3, in the 2012 Interim ROD Amendment (IRODA). This interim remedy amendment is expected to take about 30 years to implement (2012 Upper Basin IRODA, Declaration, page 12). It is also noted that "[t]he Selected Remedy is expected to result in significant improvements to surface water quality in the

Upper Basin and may achieve ambient water quality criteria (AWQC) ARARs under the Clean Water Act at many locations; however, the remedy may not achieve these ARARs at all locations."

As discussed in the 2012 IRODA, major components of the remedial actions within the Bunker Hill Box (OU 1 and OU2) include expansion and upgrade of the CTP to provide treatment of collected groundwater from OU 2, consistent achievement of updated discharge requirements, allowing for operation in high-density sludge mode, reduction of the volume of waste sludge generated, and conveyance of the CTP effluent directly to the South Fork of the Coeur d'Alene River in a pipeline. Also identified are components of the remedial actions in the Upper Basin outside the Box including additional expansion and upgrades to the CTP necessary to provide treatment of collected, contaminated water from OU 3 to consistently achieve discharge requirements.

II. Receiving Water

The upgraded CTP will discharge to the South Fork of the Coeur d'Alene River (SFCDR) near the City of Kellogg. As summarized below, available information about the flow and quality of the receiving water was used to establish appropriate requirements for the discharge.

A. Water Quality Standards

Overview

Section 301(b)(1)(C) of the Clean Water Act (CWA) requires the development of limitations in permits necessary to meet water quality standards. Federal regulations at 40 CFR § 122.4(d) require that the conditions in NPDES permits ensure compliance with the water quality standards of all affected states. A state's water quality standards are composed of use classifications, narrative and numeric water quality criteria, and an anti-degradation policy. The use classification system designates the beneficial uses that each water body is expected to achieve, such as drinking water supply, contact recreation, and aquatic life. The narrative and numeric water quality criteria are the criteria deemed necessary by the state to support the beneficial use classification of each water body. The anti-degradation policy represents a three-tiered approach to maintain and protect various levels of water quality and uses.

Designated and Existing Beneficial Uses

The upgraded CTP will discharge to the SFCDR in the South Fork Coeur d'Alene River subbasin (USGS HUC 17010302 and Idaho Assessment Unit ID17010302PN001_04). At the point of discharge, the SFCDR is protected for the following designated and existing uses as specified in IDAPA 58.01.02.150.10:

Designated Uses:

- COLD - Cold Water Communities
- SCR – Secondary Contact Recreation

Existing Use:

- SS – Salmonid Spawning

In addition, the Idaho water quality standards (WQS) state that all waters of the state of Idaho are protected for industrial and agricultural water supply (Section 100.03.b and c.), wildlife habitats (100.04) and aesthetics (100.05). The WQS state in Sections 252.02, 252.03 and 253 of the Idaho Administrative Code (IDAPA 58.01.02) that these uses are to be protected by general criteria (sometimes referred to as narrative) which are stated in Section 200. The WQS also state, in Section 252.02 that the criteria from *Water Quality Criteria 1972*, also referred to as the "Blue Book" (EPA-R3-73-033), can be used to determine numeric criteria for the protection of the agricultural water supply use.

Surface Water Quality Criteria

The WQS establish both general and numeric surface water quality criteria that apply to all surface waters. The general criteria (IDAPA 58.01.02.200) state that all surface waters of the state shall be free from:

- hazardous materials,
- toxic substances,
- deleterious materials,
- radioactive materials,
- floating, suspended or submerged matter,
- excess nutrients,
- oxygen-demanding materials

Surface water level shall not exceed allowable level for:

- radioactive materials, or
- sediments

If the natural background conditions exceed any criterion then that criterion does not apply, but rather, there shall be no lowering of water quality from the natural background condition.

The WQS establish numeric criteria (IDAPA 58.01.02.210) that apply to waters designated for aquatic life, recreation, and domestic water supply. The numeric criteria establish the maximum concentration of a pollutant that can be present in surface waters.

The WQS establish additional surface water criteria to protect aquatic life uses (IDAPA 58.01.02.250). These include pH and total concentration of dissolved gasses which apply to all aquatic life designations and dissolved oxygen, temperature, ammonia, and turbidity, which have unique criteria depending on the beneficial use designations of cold water, salmonid spawning, seasonal cold water or warm water.

The WQS establish surface water quality criteria for recreational use designation (IDAPA 58.01.02.251). Waters designated for recreation are not to contain *E. coli* bacteria in concentrations that exceed the established criterion as prescribed for secondary contact recreation.

Antidegradation

Federal water quality standards (40 CFR 131.12) require states to develop antidegradation policies to protect existing and designated beneficial uses of surface waters. Idaho antidegradation policy contained in Section 051 of the Idaho Water Quality Standards establishes three tiers of water quality protection. Tier 1 protection ensures that existing uses of all surface waters in Idaho are maintained and protected. Tier 2 level of protection is extended to high quality waters which are better than necessary to support Clean Water Act “fishable/swimmable” uses. Tier 3 level of protection maintains and protects water quality in outstanding resource waters.

EPA’s planned upgrades to the CTP are consistent with Idaho’s antidegradation policies. The CTP currently reliably treats up to 3.2 million gallons per day (MGD) in compliance with the 1986 NPDES discharge limits. The upgraded CTP will be designed and operated to meet standards that will not result in degradation of the receiving water quality.

The plant upgrades are anticipated to result in a net reduction of cadmium, lead, zinc and other metals, and TSS. In conjunction with the CTP upgrades, metals-contaminated groundwater that currently flows into the South Fork untreated will be collected and treated in the CTP. Dissolved zinc is considered an appropriate indicator for dissolved metals in surface water and groundwater because it occurs at the highest concentrations; it is relatively mobile compared to other metals; and dissolved metals (particularly cadmium) appear well correlated with dissolved zinc throughout the Upper Basin. Concentrations of dissolved cadmium and zinc in wells within the capture zone of the groundwater collection system range from 0.05-0.72 mg/L and 1.5 – 36.9 mg/L, respectively. Considering the seasonal variability, and groundwater monitoring data from south of Interstate 90 (I-90), the estimated zinc loading to the gaining reach of the SFCDR ranges from 250 to 450 lbs/day. The zinc load moving through the system toward Smelterville Flats is an additional 60 to 90 lb/day. By capturing and treating the contaminated groundwater, estimated zinc loading to the SFCDR will be reduced by 60 to 90 percent, depending on the quality of groundwater remaining outside of the capture zone. No new pollutants will be added to the river, rather there will be a significant net reduction in all contaminants of concern (primarily cadmium, lead, and zinc).

B. Receiving Water Quality

Receiving water quality is used to evaluate the overall impact of the discharge on receiving water. The EPA used the following U.S. Geological Survey (USGS) monitoring location to determine receiving water quality (Figure 1) and to evaluate the reasonable potential of the discharge to contribute to violations of the WQS:

Upstream Site:	USGS 12413210 SF COEUR D ALENE AT ELIZABETH PARK NR KELLOGG, ID Latitude 47° 31'53", Longitude 116° 05'33"

The following are downstream locations from the CTP discharge (Figure 1):

Downstream Site:	USGS 12413300 SF COEUR D ALENE RIVER AT SMELTERVILLE, ID Latitude 47°32'54", Longitude 116°10'31"
Downstream Site:	USGS 12413470 SF COEUR D ALENE RIVER NR PINEHURST, ID Latitude 47°33'07", Longitude 116°14'11"

The State of Idaho has identified the following parameters as causes of water quality impairments for the South Fork Coeur d'Alene River (from Big Creek to Pine Creek):

- cadmium
- lead
- sedimentation/siltation – Approved Total Maximum Daily Load (TMDL) with wasteload allocation for the CTP (See Table 1)
- zinc

Approximately 3.5 miles downstream from the proposed new CTP outfall are the Page Wastewater Treatment Plant (WWTP) and Smelterville WWTP outfalls. Change in pH and/or temperature of the river brought about by the CTP discharge could potentially affect ammonia toxicity for these dischargers. The chemical form of ammonia in water consists of two species: ammonium ion (NH_4^+) and un-ionized ammonia (NH_3). For convenience, the sum of these two forms (expressed as N) is referred to as total ammonia nitrogen, or TAN. The aquatic toxicity of TAN is attributed to the unionized NH_3 form (*Quality Criteria For Water* [the "Red Book"], July 1976). The ratio of these two species in water is dependent upon pH and temperature. In general, the ratio of NH_3 to NH_4^+ in fresh water increases 10-fold for each rise of 1 pH unit, and by approximately 2-fold for each 10°C rise in temperature from 10-30°C (*Aquatic Ambient Water Quality Criteria for Ammonia – Freshwater 2013*, EPA 822-R-13-001, August 2013).

The upgraded CTP discharge is not expected to have an appreciable effect on either temperature or pH in the SFCDR at the Page and Smelterville WWTP outfalls. Although CTP effluent temperature is not currently monitored as part of its discharge requirements, the effluent temperature is reported to average about 13°C and range from approximately 2-20°C (personal communication with the CTP operator). Given that the maximum receiving water temperature reported for the Elizabeth Park gage is 20.5°C, little or no increase in temperature in the SFCDR is expected to result from the upgraded CTP discharge.

Likewise, it is expected that CTP effluent at a pH as high as 10 end-of-pipe, would likely have little effect on the mixed pH at the Smelterville and Page outfalls, which both discharge to the SFCDR downstream from the planned CTP discharge location. Although it is not certain what pH the upgraded CTP will operate at in the future, pilot testing suggested that a higher pH than currently employed, and potentially as high as 9.5-10, will be required to comply with the discharge limits (e.g., for cadmium and zinc). EPA's evaluation of pH resulting from mixing between CTP discharge and the SFCDR indicates that during minimum river pH conditions, the CTP effluent could increase the downstream pH from 6.1 to 6.4, and during maximum river pH conditions, it could raise the downstream pH from 7.8 to 8.1. These are modest increases assume the chronic dilution factor of 2.4, which is based on effluent mixing with 25% of the upstream flow at 7Q10 low flow conditions. Thus, at higher river flows and/or after further mixing between effluent and river water downstream, the effect of effluent pH would be lower. For example, if the dilution factor were increased to 4.8 and 9.6, respectively, assuming effluent mixes with 50% and 100% of the river flow by the time it reaches the municipal outfalls, the resulting pH values during maximum river pH conditions would be 7.9 for both dilution factors, compared to 7.8 upstream from the CTP effluent.

C. Receiving Water Quantity

The EPA determined critical design flows in the vicinity of the discharge considering stream flow data from the same upstream USGS monitoring location as used to evaluate receiving water quality

USGS 12413210 SF COEUR D ALENE AT ELIZABETH PARK NR KELLOGG, ID.

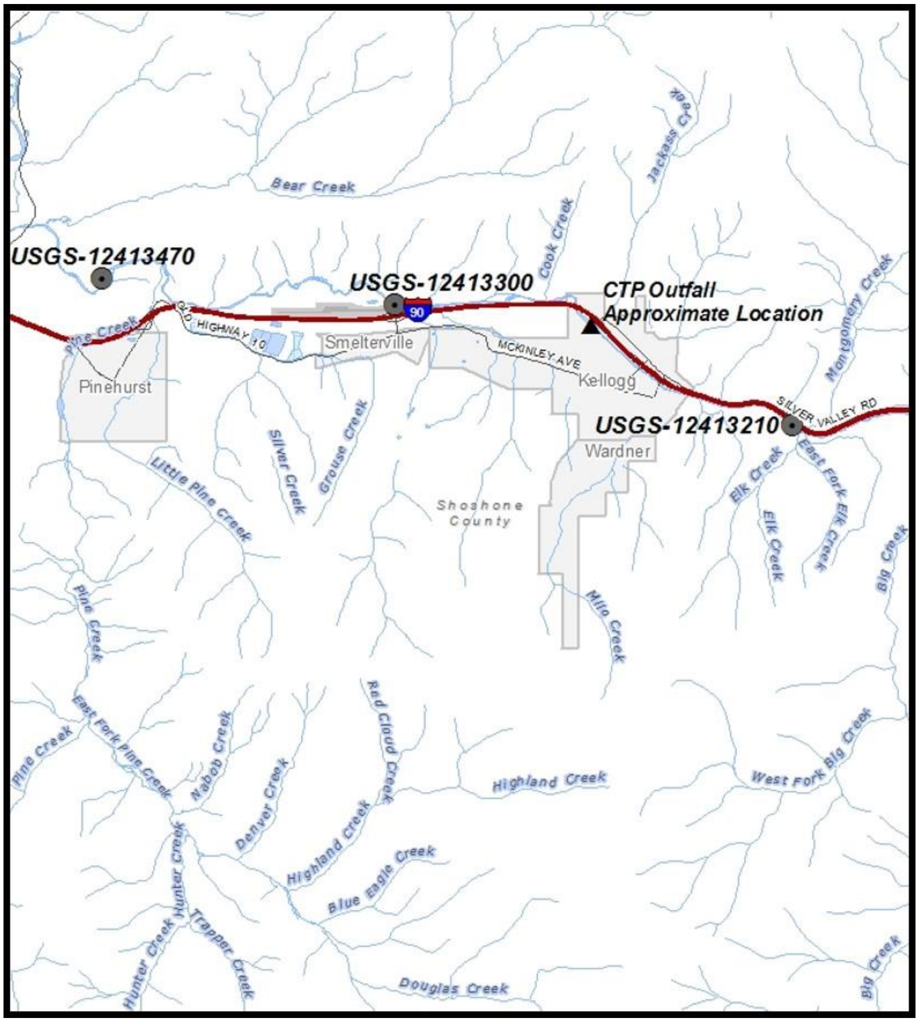
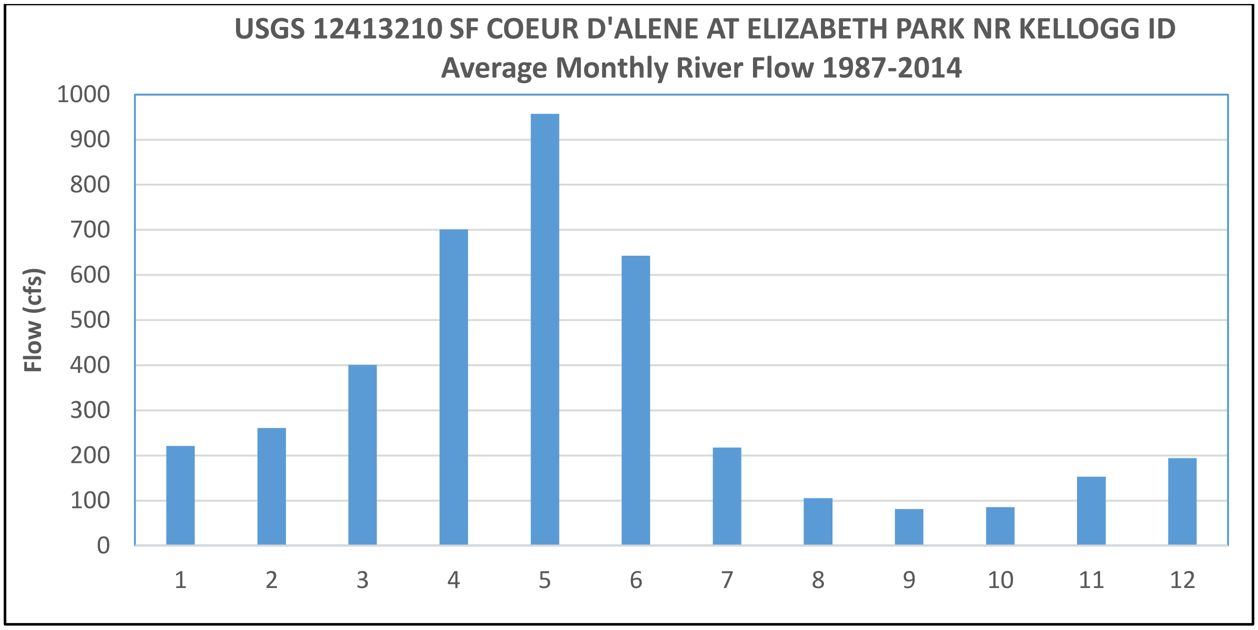


Figure 1. River Flow Monitoring Stations in the Vicinity of the Outfall

The Elizabeth Park gage was used to establish critical river flows in the vicinity of the discharge for the CTP. The Elizabeth Park monitoring location has daily flow data records for 27 years, beginning in 1987 through the present. Figure 2 shows the average monthly flows for 1987 through 2014.



cfs = cubic feet per second

Figure 2. South Fork Coeur d'Alene River Flow – Seasonal Variation

The critical design flows were calculated for the CTP using the EPA software tool BASINS (Better Assessment Science Integrating Point & Non-point Sources)[1]. The most recent version of BASINS integrates DFLOW, which is the computer code developed by EPA to estimate design stream flows for use in reasonable potential evaluation for discharge limits and TMDL waste load allocations.

Table 1 presents critical river flows calculated using the approximately 27 years of daily flow data for the SFCDR at the Elizabeth Park gage. These critical flows, and the associated mixing zone dilution factors (discussed below), were calculated on an annual basis instead of splitting the data into low- and high-flow portions of the year (as done for some other permits in the area).

Table 1. Critical Flows – South Fork Coeur d'Alene River at Elizabeth Park

Critical Flow Parameter[1]	Flow (cfs)
1Q10	41.57
7Q10	52.16
30B3	57.1
30Q5	60.45
Harmonic Mean	143

1. Appendix D of the Technical Support Document for Water Quality-Based Toxics Control (TSD) (EPA, 1991) and Section 210 of the Idaho WQS state that WQBELs intended to protect aquatic life uses should be based on the lowest seven-day average flow rate expected to occur once every ten years (7Q10) for chronic criteria and the lowest one-day average flow rate expected to occur once every ten years (1Q10) for acute criteria.

[1] Water Quality Models and Tools – BASINS (http://water.epa.gov/scitech/datait/models/basins/index.cfm)

D. Mixing Zone and Dilution Factors

A mixing zone is an area where an effluent discharge undergoes initial dilution and is extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where the water quality standards may be exceeded as long as acutely toxic conditions are prevented (U.S. EPA NPDES Permit Writers' Manual, 2010[2]). The federal regulations at 40 CFR 131.13 state that "States may, at their discretion, include in their State standards, policies generally affecting their application and implementation, such as mixing zones, low flows and variances."

The Idaho Water Quality Standards at IDAPA 58.01.02.060 provides Idaho's mixing zone policy for point source discharges. The policy allows the Idaho Department of Environmental Quality (IDEQ) to authorize a mixing zone for a point source discharge after a biological, chemical, and physical appraisal of the receiving water and the proposed discharge. Mixing zones can be used only when there is adequate receiving water flow volume and the receiving water meets the criteria necessary to protect the designated uses of the water body. Whether or not a mixing zone is appropriate depends on the assimilative capacity of the receiving waters[3]. For this reason, a mixing zone is not appropriate for cadmium, lead, and zinc in the SFCDR. This is also the case for the sedimentation/siltation TMDL wasteload allocation for TSS. Mixing zones also have the potential to impact aquatic life. Both physical and chemical impacts to the receiving water can create a barrier to upstream or downstream movement by fish and aquatic macroinvertebrates. Therefore, the mixing zone should not cause unreasonable interference with, or interference to, beneficial uses including blocking or impeding passage to any life stage of fish or other aquatic life[4].

The following formula is used to calculate a dilution factor based on the allowed mixing.

Dilution Factor $$DF = \frac{Q_d + Q_{\text{critical flow}} \times (\text{percentage of river allowble for mixing})}{Q_d}$$

Where Q_d = receiving water flow rate downstream of the effluent discharge (cfs); $Q_{\text{critical flow}}$ = applicable critical river flow (cfs).

Idaho's water quality standards address allowable mixing zones for adjacent outfalls. This portion of the rule applies to overlapping discharges. Single mixing zones are allowed 25% of the width and volume.

[2] http://www.epa.gov/npdes/pubs/pwm_2010.pdf, p. 6-20.

[3] Assimilative capacity is the difference between the background concentration of a chemical and the concentration specified for the most stringent water quality criterion (Cairns 1977; EPA1998)

[4]IDAPA 58 – DEQ 58.01.02 – Water Quality Standards Docket No. 58-0102-1401 Notice of Rulemaking – Proposed Rulemaking. Mixing Zone Policy 060.01(d)(i). www.deq.idaho.gov/58-0102-1401

Excerpt [IDAPA 58.01.02.060]

e. Mixing zones in flowing receiving waters are to be limited to the following: (7-1-93)

i. The cumulative width of adjacent mixing zones when measured across the receiving water is not to exceed fifty percent (50%) of the total width of the receiving water at that point; (7-1-93)

ii. The width of a mixing zone is not to exceed twenty-five percent (25%) of the stream width or three hundred (300) meters plus the horizontal length of the diffuser as measured perpendicularly to the stream flow, whichever is less; (7-1-93)

iii. The mixing zone is to be no closer to the ten (10) year, seven (7) day low-flow shoreline than fifteen percent (15%) of the stream width; (7-1-93)

iv. The mixing zone is not to include more than twenty-five percent (25%) of the volume of the stream flow; (7-1-9)

For the reasonable potential analysis, dilution factors were conservatively calculated using critical flows for the SFCDR at the Elizabeth Park gage, 25% of the river flow, and the CTP design flow, defined as the estimated future monthly average effluent flow (Table 2). The design flow presented in Table 2 (6.03 million gallons per day [mgd]) is for the purpose of calculating dilution factors to support discharge limits. The value is based on the maximum monthly flow for a representative period of record plus the addition of anticipated groundwater flow; it is not the design flow capacity of the upgraded CTP.

Table 2. Annual Flows

Plant Data	Units	Design Flow	
Design Flow	mgd	6.03[1]	
Design Flow	cfs - calculated	9.33	
Annual Flows			
Critical Flow Parameter		**River Flow (cfs)**	**Used for evaluating criteria for:**
1Q10		**41.57**	**Aquatic Life Uses - Acute**
7Q10		**52.16**	**Aquatic Life Uses - Chronic**
30B3		57.1	**Ammonia**
30Q5		**60.45**	**Human Health – Non-carcinogen**
Harmonic Mean		**143**	**Human Health – Carcinogen**
Calculation of Dilution Factors based on Critical Design Flows and design Flows			
Dilution Factors	**Allowable % of river flow**	**Dilution Factor**	**Basis**
DF-edge of Acute zone	25%	**2.1**	**1Q10**
DF-edge of Chronic zone	25%	**2.4**	**7Q10**
Ammonia	25%	**2.5**	**30B3**
HH-Non-Carcinogen	25%	**2.6**	**30Q5**
HH-Carcinogen	25%	**4.8**	**Harmonic Mean**

[1] EPA uses the maximum monthly flow for the Design Flow for the purpose of calculating dilution factors. In this case, 6.03 MGD (4,189 gpm) was determined as the maximum monthly flow of mine water at the CTP for the representative period of record (Jan 2000 - May 2014) of 2,189 gpm in May 2000 plus the projected flow of OU2 groundwater to be treated at the upgraded CTP of 2,000 gpm determined via modeling. The design flow presented in Table 3 is not to be confused with the plant design flows set forth in Phase 2 Solicitation Section 01 10 00, Section 3.1, which are to be used as the basis for design.

III. Basis for Discharge Criteria

The following discussion explains in more detail the statutory and regulatory basis for the technology and water quality-based effluent limits presented in this Fact Sheet to meet the substantive requirements of the NPDES permit program as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Section 121(d) of the CERCLA requires attainment of Federal ARARs and of State ARARs. CERCLA Section 121(e)(1) provides that no Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with Section 121. Consistent with CERCLA §121(e)(1), on-site discharge from a CERCLA site to surface waters, as in the case of the CTP, must meet the substantive CWA NPDES requirements, but need not obtain an NPDES permit nor comply with the administrative requirements of the permitting process including the certification requirements.

EPA's 2001 Mine Water RODA identified aluminum, arsenic, cadmium, copper, iron, lead, mercury, manganese[5], selenium, thallium, silver, and zinc as the metals in the discharge from the CTP. The key ARARs identified for establishing acceptable limits for the discharge from the CTP include the Idaho Water Quality Standards and the National Recommended Water Quality Criteria for the contaminants of concern. EPA's 2012 IRODA, which incorporates and updates previous RODs, identifies the following as contaminants of concern in surface water: arsenic, cadmium, copper, lead, mercury, and zinc.

To implement the ARARs provision, EPA developed guidance, *CERCLA Compliance With Other Laws Manual: Parts I and II*. The guidance provides specific information on CERCLA compliance with the CWA. For CWA direct discharge requirements, the guidance lays out the following that apply to the CTP:

1. Substantive Requirements

a. Ambient Water Quality Standards

Federal Water Quality Criteria (WQC) - Federal WQC are non-enforceable guidelines that set concentrations of pollutants which, when published, were considered adequate to protect surface waters. The WQC may be relevant and appropriate to CERCLA cleanups based upon an evaluation of four criteria set forth in CERCLA section 121(d): 1) uses of the receiving water body; 2) media affected; 3) purposes of the criteria; and 4) current information.

b. Effluent Standards

Technology Based Limitations - CWA section 301(b) requires that, at a minimum, all direct discharges meet technology-based limits. Technology-based requirements for conventional pollutant discharges include application of the best conventional pollutant control technology (BCT). For toxic and nonconventional pollutants, technology based requirements include the best available technology economically achievable (BAT). Because there are no national effluent limitation regulations for releases from CERCLA sites, technology based treatment requirements are determined on a case-by-case basis using best professional judgment (BPJ) to determine BCT/BAT equivalent discharge requirements. Technology based limits for water discharges are often expressed as concentration levels. Technology based limits are applicable to direct discharges from a point source.

With the exception of TSS, for all of the other parameters for which technology-based effluent limits have been established, EPA determined that the technology-based effluent limits are not stringent enough to ensure compliance with water quality standards in the receiving waters. Therefore, EPA is required by Section 301(b)(1)(C) of the CWA to establish “more stringent limitation(s)…necessary to meet water quality standards.”

Effluent limitations for TSS and water quality-based effluent limitations are discussed below.

[5] The manganese human health criterion is based on consumption of marine mollusks, dating back to the 1976 EPA Red Book. Since the CTP discharges to fresh water, this criterion is not applicable to the CTP therefore no discharge limit was developed for manganese.

A. Effluent Limitations for Total Suspended Solids

Technology-based Effluent Limits for TSS

The technology-based effluent limits for TSS are 20 mg/L for average monthly limit and 30 mg/L maximum daily limit. EPA has determined that it is not necessary to impose more stringent, water quality-based effluent limits on the discharge of total suspended solids, in order to ensure compliance with Idaho's water quality standards.

The State of Idaho has a narrative water quality criterion for sediment (IDAPA 58.01.02.200.08). Other sources provide appropriate numeric limits and targets for suspended sediment. Suggested limits for suspended sediment have been developed by the European Inland Fisheries Advisory Commission and the National Academy of Sciences, and have been adopted by the State of Idaho in previous TMDLs. A limit of 25 mg/L of suspended sediment provides a high level of protection of aquatic organisms; 80 mg/L moderate protection; 400 mg/L low protection; and over 400 mg/L very low protection (USDA FS 1990, Thurston et al. 1979).

The technology-based average monthly limit for TSS is less than 25 mg/L, a concentration that provides a high level of protection of aquatic organisms. Therefore, the technology-based TSS limit is adequate to protect water quality.

Water Quality Limited Segment and SFCDR Total Maximum Daily Load (TMDL)

A water quality limited segment is any waterbody, or definable portion of a waterbody, where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards. In accordance with section 303(d) of the Clean Water Act, States must identify waters not achieving water quality standards in spite of the application of technology-based controls in NPDES permits for point sources. Such waterbodies are known as water quality limited segments (WQLSs), and the list of such waterbodies is called the "303(d) list." Once a water body is identified as a WQLS, the States are required under the Clean Water Act to develop TMDL. A TMDL is a determination of the amount of a pollutant, or property of a pollutant, from point, nonpoint, and natural background sources (including a margin of safety) that may be discharged to a water body without causing the water body to exceed the water quality criterion for that pollutant.

SFCDR is listed in Idaho's 2002/2004 303(d)/305(b) integrated report as not supporting the beneficial use of cold water aquatic life, due to physical substrate habitat alterations and sedimentation and siltation. In August 2002, EPA approved a TMDL for the SFCDR. The TMDL included a waste load allocation (WLA) for the CTP (see Table 3). In order to meet the substantive requirements of the Idaho TMDL for the SFCDR Subbasin, the annual average WLA for TSS for the CTP will be 56.1 tons/year (*South Fork Coeur d'Alene River Sediment Subbasin Assessment and Total Maximum Daily Load, IDEQ, 2002*).

Table 3: Waste load allocation to the Permitted Point Discharges of the South Fork Coeur d'Alene River Subbasin[a].

Permitted Discharge	Total Suspended Solids Limit (mg/L)	Average Discharge (MGD)	Revised Discharge Limit (MGD)	Annual Average Load (tons/yr)	Revised Annual Load (tons/yr)
Central Treatment Plant	**20**	**2.05**	**1.85**	**62.3**	**56.1**

[a] Table from South Fork Coeur d'Alene River Subbasin Assessment and Total Maximum Daily Load showing allocations to point discharges, approved by EPA on August 21, 2003

B. Water Quality-Based Effluent Limitations (WQBELs) for Cu, Zn, Pb, Hg and pH

Statutory and Regulatory Basis

Section 301(b)(1)(C) of the CWA requires the development of limitations in permits necessary to meet water quality standards by July 1, 1977. Discharges to State or Tribal waters must also comply with limitations imposed by the State or Tribe. Federal regulations at 40 CFR 122.4(d) prohibit the issuance of a NPDES permit that does not ensure compliance with the water quality standards of all affected States.

The NPDES regulation 40 CFR 122.44(d)(1) implementing Section 301(b)(1)(C) of the CWA requires that permits include limits for all pollutants or parameters which are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State or Tribal water quality standard, including narrative criteria for water quality, and that the level of water quality to be achieved by limits on point sources is derived from and complies with all applicable water quality standards.

The regulations require the permitting authority to make this evaluation using procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant in the effluent, species sensitivity (for toxicity), and where appropriate, dilution in the receiving water. The limits must be stringent enough to ensure that water quality standards are met, and must be consistent with any available wasteload allocation.

Procedure for Deriving Water Quality-Based Effluent Limits

The first step in developing a water quality-based effluent limit is to develop a wasteload allocation (WLA) for the pollutant. A wasteload allocation is the concentration or loading of a pollutant that may be discharged without causing or contributing to an excursion above water quality standards in the receiving water.

In cases where a mixing zone is not authorized, because the receiving water already exceeds the criterion, the receiving water flow is too low to provide dilution, or the State does not authorize one, the criterion becomes the WLA. Establishing the criterion as the wasteload allocation ensures that the discharge will not cause or contribute to an excursion above the criterion. The following discussion details the specific water quality-based effluent limits in the draft permit.

Once a WLA is developed, EPA calculates effluent limits which are protective of the WLA using statistical procedures.

Applicable Water Quality Standards (or Criteria)

Water quality criteria specify the level of water quality that is necessary to support a waterbody's designated uses. At the point of discharge, the SFCDR is designated for the uses of cold water aquatic life and primary contact recreation, (IDAPA 58.01.02.150.10). In addition, all waters of the State of Idaho are designated for industrial and agricultural water supply, wildlife habitats, and aesthetics (IDAPA 58.01.02.100).

Different water quality criteria are associated with the various uses. For each water quality parameter, water quality-based effluent limits must be based on the most stringent water quality criterion applicable to the receiving water, in order to ensure that all of the uses are protected. The applicable water quality criteria, based on the designated uses of the receiving waters, are listed in Table 4.

Table 4: Idaho Water Quality Criteria Applicable to South Fork Coeur d'Alene River		
Parameter	**Criteria**	**Uses**
Arsenic	Acute: 340 µg/L Chronic: 150 µg/L	Cold Water Aquatic Life
Cadmium	Dependent upon hardness. See below.	Cold Water Aquatic Life
Copper	Dependent upon hardness. See below.	Cold Water Aquatic Life
Mercury, Water Column**	Acute: 2.1 µg/L Chronic: 0.012 µg/L	Cold Water Aquatic Life
Lead	Dependent upon hardness. See below.	Cold Water Aquatic Life
Nitrate + Nitrite* (Statewide)	100 mg/L	Agricultural Water Supply
pH	6.5 – 9.0 standard units	Aquatic Life
Selenium	Acute: 20 µg/L Chronic: 5 µg/L	Cold Water Aquatic Life
Silver	Dependent upon hardness. See below.	Cold Water Aquatic Life
Temperature*	Water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C	Cold Water Aquatic Life
Thallium	0.47 µg/L	Human Health Organisms Only
Whole Effluent Toxicity	"Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses." See below for numeric interpretation.	Cold Water Aquatic Life, other designated uses.
Zinc	Dependent upon hardness. See below.	Cold Water Aquatic Life

* Per CERCLA Section 121(d), the CTP upgrades are focused on the COCs outlined in EPA's decision documents for the site. Nitrate + Nitrite and Temperature are not identified as COCs and therefore have not been evaluated.
** On December 12, 2008, the EPA disapproved Idaho's removal of its aquatic life criteria for mercury in the water column. The aquatic life water column criteria for total recoverable mercury that the EPA approved in 1997 remain in effect for Clean Water Act purposes. These are an acute criterion of 2.1 µg/L and a chronic criterion of 0.012 µg/L.

Hardness Dependent Metals Criteria

The numeric values of the aquatic life water quality criteria for certain metals vary with the hardness of the receiving water. Hardness is a measure of the concentration of divalent metal cations (mostly calcium and magnesium) in the water. Some metals are less toxic to aquatic life in hard water than in soft water, therefore, the water quality criteria become less stringent (i.e. numerically greater) in harder waters. Table 5 lists the hardness of the effluent and the receiving water for various conditions.

Table 5: Hardness of Effluent and Receiving Water	
Description	**Hardness (mg/L as CaCO3)**
Fifth percentile effluent hardness at outfall (end-of-pipe)	676
Fifth percentile hardness in SFCDR, Elizabeth Park, upstream from outfall , with flows less than 71 cfs	66.5
Fifth percentile hardness in SFCDR, Elizabeth Park, upstream from outfall, all flows	22.1
Mixed Hardness at edge of acute and chronic mixing zones	Acute: 331.5 Chronic: 294.9

Per Idaho's Water Quality Standards at IDAPA 58.01.02.210.03.c.ii: "The hardness values used for calculating aquatic life criteria for metals at design discharge conditions shall be representative of the ambient hardnesses for a receiving water that occur at the design discharge conditions given in Subsection 210.03.b." The reference to 210.03.b provides the 1Q10/1B3 and 7Q10/4B3 design conditions for aquatic life criteria. Table 6 presents the flow tiers as percentiles of upstream flow in SFCDR at Elizabeth Park along with the average and 5th percentile hardness for each flow tier. Where receiving water hardness was used to calculate the WQC, the 5th percentile at the < 71 cfs flow tier was used to represent the receiving water. Where the mixed hardness was used to calculate the WQC, the 5th percentile hardness of 22.1 mg/L was used for the river hardness.

The Idaho standards state that the maximum hardness allowed for use in those equations shall not be greater than four hundred (400) mg/L, as calcium carbonate, except as specified in Subsections 210.03.c.ii. and 210.03.c.iii., even if the actual ambient hardness is greater than four hundred (400) mg/L as calcium carbonate. As this is the case, the maximum effluent hardness used for hardness dependent parameters not allowed a mixing zone is 400 mg/l, although this is considerably lower than the 5th percentile effluent hardness at the outfall.

Table 6: Flow Tiers and Associated Hardness

Flow Tier (percentile of upstream flow in SFCDR at Elizabeth Park)	**Flow Tier (cfs)**	**Q_u[1] (cfs)**	**Avg. Hardness (mg/L as CaCO3)**	**5th Percentile Hardness (mg/L as CaCO3)**
< 10th	< 71 cfs	41.6 (acute)	73.9	66.5
		52.2 (chronic)		
		60.5 (HH)		
10th to < 50th	71 to < 165 cfs	71	66.3	57.5
50th to < Halfway between the 50th and 90th percentiles	165 to < 508 cfs	165	48.9	35.0
Halfway between the 50th and 90th percentiles to < 90th	508 to < 851 cfs	508	35.2	28.7
> 90th	> 851 cfs	851	27.4	19.9

1. Qu = receiving water flow rate upstream of discharge.

As shown in Table 5, the effluent is considerably harder than the receiving water. The fact that the effluent is relatively hard decreases the toxic impact of the effluent, relative to what it would have been if the effluent had been soft. EPA has considered this in the development of effluent limits for metals.

Influence of Hard Effluent on Cadmium, Copper, and Zinc

For cadmium, copper, and zinc, the influence of the hard effluent is considered in the development of effluent limits by calculating the values of the water quality criteria using the hardness expected to occur at the point where the criteria are being applied, whether that be at the end-of-pipe or at the edge of the mixing zone. This means, in cases where water quality criteria are being applied at the end-of-pipe (i.e., for cadmium and zinc), the effluent hardness has been used to calculate the value of the water quality criteria. In cases where a mixing zone is proposed (i.e., for copper), the hardness of the mixture of the effluent and the receiving water (at the edge of the mixing zone, under critical conditions) has been used. A hardness value was calculated for the edges of both the acute and chronic mixing zones. Table 8 lists the hardness values used to calculate the water quality criteria of the cadmium, copper, and zinc.

Using a hardness value that considers the fact that the effluent is harder than the receiving water to calculate the values of the water quality criteria makes the water quality criteria less stringent than they would be if the hardness of the receiving water were used. However, applying the water quality criteria in this manner nonetheless results in effluent limits that are derived from and comply with water quality criteria for cadmium, copper, and zinc, as required by 40 CFR 122.44(d)(1)(vii)(A)). This is because any mixture of two waters, which each meet water quality criteria for cadmium, copper, and zinc at their respective hardness, will also meet criteria for these metals.

The reason for this is that, when the criteria for cadmium, zinc, and copper are plotted against hardness, the shape of the curve is “concave down,” meaning, the slope of the curve decreases with increasing hardness (i.e. the value of the second derivative is always negative). Because the shape of the criteria curve is concave down, all of the points on this line, representing all of the possible mixing proportions of the two waters, will always lie below the criterion, as long as each individual water has a cadmium, zinc or copper concentration less than or equal to the criterion, at its respective hardness.

Influence of Hard Effluent on Silver and Lead

The influence of the hard effluent cannot be considered directly in the calculation of effluent limits for silver and lead, as it can be for cadmium, copper and zinc. For silver and lead, the shape of the curve is “concave up.” As explained above, when two waters are mixed, the hardness and metal concentration of the mixture will fall somewhere on a straight line connecting the points representing the hardness and metal concentrations of the two waters prior to mixing, and when the criterion curve is concave down, this straight line always lies below the criterion curve. When the criterion curve is concave up, this straight line may not be below the criterion curve.

To calculate the values of the water quality criteria for silver, EPA has applied the hardness at the edge of the mixing zone (5^{th} percentile effluent hardness mixed with 5^{th} percentile upstream receiving water hardness). For lead, EPA has applied the ambient hardness for receiving water at 1Q10 and 7Q10 design conditions; the 5th percentile at < 71 cfs.

This approach considers the influence of the relatively hard water discharged, while ensuring compliance with water quality standards under critical conditions. This approach is consistent with how discharge criteria for numerous other NPDES permitted facilities were calculated. In the recently issued City of Coeur d’Alene, ID, Hayden Area, ID Regional Sewer Board, and City of Post Falls, ID permits (Permit Numbers: ID0022853, ID0026590 and ID0025852) effluent hardness was used to calculate the metals water quality criteria. These discharge limits were put in place to be protective of the downstream Spokane River TMDL, which also utilized this approach to calculate other discharge limits for dischargers in Washington waters. This approach of using effluent hardness to establish metals water quality criteria is described in the Spokane River TMDL technical support documentation (Washington Department of Ecology, 1998).

Metals Criteria Summary

Site-specific water quality criteria (SSC) that reflect local environmental conditions are allowed by federal and state regulations. 40 CFR 131.11 provides States with the opportunity to adopt water quality criteria that are "…modified to reflect site specific conditions."[6] SSC for cadmium, lead and zinc were adopted for the SFCDR by IDEQ and approved by EPA. Using the hardness values discussed above, the following equations in Table 7 were used to calculate the numeric criteria for these pollutants. It was assumed that no mixing zone would be authorized and water quality criteria would be met at the end of pipe.

Table 7. Site Specific Criteria Equations for Cadmium, Lead, and Zinc

Parameter	CMC[1] (µg/L)	CCC[2] (µg/L)
Cadmium	[0.973] x exp[1.0166 x ln(hardness)-3.924]	[1.101672-ln(hardness) x 0.041838] x exp[0.7852 x ln(hardness)-3.49]
Lead	Exp[0.9402 x ln(hardness)+1.1834]	Exp[0.9402 x ln(hardness)-0.9875]
Zinc	Exp[0.6624 x ln(hardness)+2.2235]	Exp[0.6624 x ln(hardness)+2.2235]

1. CMC = Criteria Maximum Concentration. EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed for a brief period of time without causing an acute effect.

2. CCC = Criteria Continuous Concentration. EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed indefinitely without causing unacceptable effect.

The hardness-dependent water quality criteria for the metals of concern are expressed as dissolved metal. The dissolved fraction of the metal is the fraction that will pass through a 0.45-micron filter. However, the federal regulation at 40 CFR 122.45(c) requires that NPDES permit effluent limits must be expressed as total recoverable metal. Total recoverable metal is the concentration of the metal in an unfiltered sample. To develop effluent limits for total recoverable metals which are protective of the dissolved metals criteria, "translators" are used in the equations to determine reasonable potential and derive effluent limits. The table below shows the applicable criteria for metals based on the appropriate hardness.

Table 8 summarizes all of the hardness values used to calculate the values of the water quality criteria for metals, and lists the resulting criteria values.

[6] Development of Site-Specific Water Quality Criteria for the South Fork Coeur d'Alene River, Idaho, Application Of Site-Specific Water Quality Criteria Developed In Headwater Reaches To Downstream Waters. Idaho Department of Environmental Quality, December 13, 2002, (http://www.deq.idaho.gov/media/445306-sfcda_criteria_downstream.pdf)

Table 8: Hardness Values Used to Calculate Water Quality Criteria for Metals				
Metal	**Hardness (mg/L as CaCO3)**	**Hardness Basis**	**Acute Criterion (µg/L)**	**Chronic Criterion (µg/L)**
Cadmium	676 (400)	5th percentile effluent hardness is 676 mg/L. Used max allowable 400 mg/L to calculate WQC	8.50	2.87
Copper	Acute: 331.5 Chronic: 294.9	Hardness at the edge of the mixing zone (5th percentile effluent hardness mixed with 5th percentile upstream receiving water hardness	52.6	28.6
Lead	66.5	Ambient hardness for receiving water at 1Q10 and 7Q10 design conditions 5th percentile at < 71 cfs.	169	19.3
Silver	Acute: 331.5	Hardness at the edge of the mixing zone (5th percentile effluent hardness mixed with 5th percentile upstream receiving water hardness	27.1	---
Zinc	676 (400)	5th percentile effluent hardness is 676 mg/L. Used max allowable 400 mg/L to calculate WQC	488.9	488.9

References:

Thurston R.V., R.C. Russo, C.M. Fetterolf, T.A. Edsall, Y.M. Barber Jr., editors. 1979. Review of the EPA Red Book: Quality Criteria for Water. Bethesda, MD. Water Quality Section, American Fisheries

U.S. Department of Agriculture Forest Service (USDA FS). 1990. Salmonid-habitat Relationships in the Western United States: A Review and Indexed Bibliography. USDA Forest Service. General Technical Report RM-188. Fort Collins, CO. Rocky Mountain Forest and Range Experiment Station, USDA FS.

U.S. Environmental Protection Agency (EPA). 2014. City of Coeur d'Alene, ID Final Wastewater Discharge Permit and Fact Sheet. (EPA Permit Number: ID0022853).

USEPA. 2014. Hayden Area ID Regional Sewer Board (HARSB) Final Wastewater Discharge Permit and Fact Sheet (EPA Permit Number: 0026590).

USEPA. 2014. City of Post Falls, ID Final Wastewater Discharge Permit and Fact Sheet (EPA Permit Number: ID0025852).

Washington Department of Ecology. 1999. Spokane River Dissolved Metals Total Maximum Daily Load Submittal Report.

Washington Department of Ecology. 1998. Cadmium, Lead and Zinc in the Spokane River. Recommendations for Total Maximum Daily Loads and Waste Load Allocations

IV. Reasonable Potential Analysis

The EPA projects the receiving water concentration (downstream of where the effluent enters the receiving water) for each pollutant of concern when evaluating the effluent to determine if water quality-based effluent limits are needed. EPA uses the concentration of the pollutant in the effluent and receiving water and, if appropriate, the dilution available from the receiving water, to project the receiving water concentration. The discharge has the reasonable potential to cause or contribute to an exceedance of the applicable water quality standard if the projected concentration of the pollutant in the receiving water exceeds the numeric criterion for that specific chemical. A water quality-based effluent limit is required if there is a reasonable potential of the pollutant to exceed the water quality criteria.

A. Methodology for Determining Reasonable Potential

The following describes the process the EPA has used to determine if the discharge authorized has the reasonable potential to cause or contribute to a violation of Idaho's federally approved water quality standards. The EPA uses the process described in the *Technical Support Document for Water Quality-based Toxics Control (*referred to as TSD*)* (EPA, 1991) to determine reasonable potential.

This section discusses how the maximum projected receiving water concentration is determined.

Mass Balance to Determine Maximum Receiving Water Concentration

For discharges to flowing water bodies, the maximum projected receiving water concentration is determined using the following mass balance equation:

$$C_dQ_d = C_eQ_e + C_uQ_u \quad \text{(Equation A-1)}$$

where,

C_d = Receiving water concentration downstream of the effluent discharge (that is, the concentration at the edge of the mixing zone)

C_e = Maximum projected effluent concentration, or 95th percentile where sufficient effluent data are available.

C_u = 90th percentile measured receiving water upstream concentration

Q_d = Receiving water flow rate downstream of the effluent discharge = Q_e+Q_u

Q_e = Effluent flow rate (set equal to the design flow, defined as the maximum monthly flow, of the WWTP)

Q_u = Receiving water low flow rate upstream of the discharge (1Q10, 7Q10 or 30B3)

When the mass balance equation is solved for C_d, it becomes:

$$C_d = \frac{C_eQ_e + C_uQ_u}{Q_e + Q_u} \quad \text{(Equation A-2)}$$

The above form of the equation is based on the assumption that the discharge is rapidly and completely mixed with the receiving stream. If the mixing zone is based on less than complete mixing with the receiving water, the equation becomes:

$$C_d = \frac{C_eQ_e + C_u(Q_u \times MZ)}{Q_e + (Q_u \times MZ)} \quad \text{(Equation A-3)}$$

Where MZ is the fraction of the receiving water flow available for dilution. In this case, the mixing zone is based on complete mixing of the effluent and the receiving water, and MZ is equal to unity (1). Therefore, in this case, Equation A-3 is equal to Equation A-2.

If a mixing zone is not allowed, dilution is not considered when projecting the receiving water concentration and,

$C_d = C_e$ (Equation A-4)

Equation A-2 can be simplified by introducing a "dilution factor,"

Dilution Factor $DF = \frac{Q_d + Q_{critical\ flow} \times (\text{percentage of river allowble for mixing})}{Q_d}$ (Equation A-5)

For the reasonable potential analysis, dilution factors were conservatively calculated based on annual flows using the CTP design flow. Table 9 provides the dilution factors used to calculate reasonable potential.

Table 9: Dilution Factors – 25% of River Flow Dilution Allowance

Dilution Factors	Dilution Factor Annual	Dilution Factor Low Flow (July - November)	Dilution Factor High Flow (December - June)
Aquatic Life - Acute Criteria - (CMC)	2.1	2.1	2.3
Aquatic Life - Chronic Criteria - (CCC)	2.4	2.4	2.6
Ammonia	2.5	2.5	2.9
Human Health - Non-Carcinogen	2.6	2.6	3.4
Human Health - Carcinogen	4.8	4.8	4.8

After the dilution factor simplification, Equation A-2 becomes:

$$C_d = \frac{(C_e - C_u)}{DF} + C_u \qquad \text{(Equation A-6)}$$

If the criterion is expressed as dissolved metal, the effluent concentrations are measured in total recoverable metal and must be converted to dissolved metal as shown in Equation A-7.

$$C_d = \left[\frac{CT \times C_e - C_u}{DF}\right] + C_u \qquad \text{(Equation A-7)}$$

Where C_e is expressed as total recoverable metal, C_u and C_d are expressed as dissolved metal, and CT is a conversion factor used to convert between dissolved and total recoverable metal.

Equations A-6 and A-7 are the forms of the mass balance equation which were used to determine reasonable potential and calculate wasteload allocations.

Maximum Projected Effluent Concentration

The EPA uses the procedure described in section 3.3 of the TSD (EPA, 1991) to calculate the maximum projected effluent concentration. The 99th percentile of the effluent data is the maximum projected effluent concentration in the mass balance equation.

Since there are a limited number of data points available, the 99th percentile is calculated by multiplying the maximum reported effluent concentration by a "reasonable potential multiplier" (RPM). The RPM is the ratio of the 99th percentile concentration to the maximum reported effluent concentration. The RPM is calculated from the coefficient of variation (CV) of the data and the number of data points. The CV is defined as the ratio of the standard deviation of the data set to the mean, but when fewer than 10 data points are available, the TSD recommends making the assumption that the CV is equal to 0.6.

Using the equations in section 3.3.2 of the TSD, the reasonable potential multiplier (RPM) is calculated based on the CV and the number of samples in the data set.

B. Reasonable Potential Determination

The reasonable potential analysis for some of the water quality-based effluent limits have been calculated using a mixing zone. The reasonable potential was calculated using a mixing zone for the following: aluminum, arsenic, copper, mercury, silver, thallium, whole effluent toxicity (WET), and pH. Based on this analysis, only zinc, cadmium, and mercury were determined to have a reasonable potential to contribute to violations of the aquatic life criteria.

Discharge limits were not included for aluminum, arsenic, iron, selenium, silver, or thallium, since the water quality-based analysis indicated that there was no reasonable potential for these metals, at the concentrations discharged, to cause or contribute to an exceedance of water quality criteria in the SFCDR (40 CFR 122.44(d)(1)(i – iii)), and there are no technology-based effluent limits applicable to these metals. Based on the CTP effluent data, neither copper nor lead has a reasonable potential to cause or contribute to excursions above their respective water quality standards. However, EPA calculated and established water quality-based limits for copper and lead because a discharge at the technology-based limits would cause violations of water quality criteria. The reasonable potential analysis for pH and WET are discussed below. Discharge limits for the CTP are presented in Table 12.

Reasonable Potential Analysis - pH

The most stringent water quality criterion for pH is for the protection of aquatic life and aquaculture water supply. The pH criteria for these uses state that the pH must be no less than 6.5 and no greater than 9.0 standard units.

EPA's technology-based Effluent Limitation Guidelines (ELGs) for the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ore Subcategory (40 CFR 440, Subpart J) specify an upper pH limit for effluent discharges of 9.0 standard units (s.u.). The ELG for pH is found in 40 CFR 440.102. The NPDES regulations at 40 CFR 122.44(a) require that permits include technology-based conditions based on ELGs. The NPDES regulations also require that permits include effluent limits based on water quality standards, where there is reasonable potential to cause or contribute to an exceedence of the water quality standard (40 CFR 122.44(d)). The water quality criteria for pH applicable to the South Fork Coeur d'Alene River (SFCDR) specify a maximum pH limit of 9.5 s.u. (cold water biota - aquatic life criteria from IDAPA 16.01.02250.01). Since the ELG of 9.0 is more stringent than the water quality criteria of 9.5, a pH limit of 9.0 would normally be included in Part I.A.3. of an effluent discharge permit.

The General Provisions found in Subpart L of the ELGs allow the permit issuer to include a pH limit higher than the ELG maximum limit under certain conditions. Specifically, the "pH adjustment provision" of the ELGs states (40 CFR 440.131(d)(1)): "Where the application of neutralization and sedimentation technology to comply with relevant metals limitations results in an inability to comply with the pH range of 6 to 9, the permit issuer may allow the pH level in the final effluent to slightly exceed 9.0 so that the copper, lead, zinc, mercury, and cadmium limitations will be achieved."

The Bunker Hill CTP employs a lime treatment "neutralization and sedimentation technology" to neutralize acidity and precipitate metals from mining-influenced water. The CTP currently operates with discharge limits that were established under an NPDES permit issued to the Bunker Hill Mining Company in 1986, and is able to comply with the relatively lenient metals limitations in that permit using a moderate treatment pH of 8.5-9.0 s.u. However, after the planned expansion and upgrades are completed, the CTP will be subject to the more stringent discharge limitations (e.g., for cadmium and zinc) outlined in this Technical Memo. It is expected that a higher treatment pH (e.g., the 9.5-10.0 s.u. range) will be required for the CTP to achieve compliance with the new limitations. This expectation is generally supported by pilot testing conducted in 2012-13 (CH2M HILL, 2013). For this reason, an upper pH limit of 10.0 s.u., might be needed to avoid having to implement post-treatment acid addition at the CTP, which would constitute additional capital and operations & maintenance (O&M) costs, and would likely be unnecessary for the protection of receiving water quality.

Calculation of the pH in the SFCDR at the 7Q10 low flow mixed with CTP effluent with a pH of 10.0 indicates that there would be no reasonable potential to contribute to exceedance of an upper pH limit of 9.0 at the edge of the chronic mixing zone downstream from the CTP outfall (see Table 10 below). In fact, discharge of CTP effluent at pH 10.0 could actually provide benefit to receiving water quality when the SFCDR pH is low. Consequently, EPA has determined that an increase in the upper pH limit from 9.0 s.u. to 10.0 s.u., per 40 CFR 440.131(d)(1) is warranted.

Table 10: Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

	Yr. Aournd Basis		
INPUT	**Min Limit**	**Max Limit**	**Comments**
1. Dilution Factor at Mixing Zone Boundary	2.4	2.4	Chronic Dilution Factor at Design Flow and Low River Flow Conditions
2. Ambient/Upstream/Background Conditions			
Temperature (deg C):	20.50	0.80	Max. and min. temperature for lower and upper pH, respectively, based on USGS data.
pH:	6.10	7.80	Min. and max. pH for lower and upper pH, respectively, based on USGS data.
Alkalinity (mg $CaCO_3$/L):	35.00	35.00	Minimum based on upstream data
3. Effluent Characteristics			
Temperature (deg C):	20.00	1.67	Max and min temperature for lower and upper pH, respectively.
pH:	**10.00**	**10.00**	
Alkalinity (mg CaCO3/L):	40.10	40.10	
OUTPUT			
1. Ionization Constants			
Upstream/Background pKa:	6.38	6.56	
Effluent pKa:	6.38	6.55	
2. Ionization Fractions			
Upstream/Background Ionization Fraction:	0.34	0.95	
Effluent Ionization Fraction:	1.00	1.00	
3. Total Inorganic Carbon			
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	101	37	
Effluent Total Inorganic Carbon (mg CaCO3/L):	40	40	
4. Condtions at Mixing Zone Boundary			
Temperature (deg C):	20.29	1.16	
Alkalinity (mg CaCO3/L):	37.13	37.13	
Total Inorganic Carbon (mg CaCO3/L):	75.87	38.31	
pKa:	6.38	6.56	
RESULTS			
pH at Mixing Zone Boundary:	**6.36**	**8.05**	Effluent limits based on WQS do not have a reasonable potential to contibute to violations of the pH standards.

References

CH2M HILL. 2013. *Water Treatment Pilot Study for CTP Upgrade and Expansion, Bunker Hill Mining and Metallurgical Complex Superfund Site*. Technical Memorandum prepared for U.S. EPA Region 10, November 12, 2013.

Reasonable Potential Analysis – Whole Effluent Toxicity

Whole Effluent Toxicity (WET) refers to the aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's effluent. At this time, the EPA is including trigger values for WET (Table 11). The rationale is explained below.

The Idaho water quality standards have a narrative criterion at IDAPA 58.01.02.200.02 that requires surface waters of the state to be free from toxic substances in concentrations that impair designated beneficial uses. This narrative criterion is the basis for establishing WET controls in NPDES permits (see 40 CFR 122.44(d)(1)). For protection against chronic effects to aquatic life the EPA recommends using 1.0 chronic toxic units (TU_c) to the most sensitive of at least three test species (*EPA Region 10 Toxicity Training Tool*, Debra Denton, Jeff Miller, Robyn Stuber, September 2007; TSD, 1991. EPA guidance note that in some cases, the optimum number of species may be fewer or more depending on such factors as the use classification and existing uses of the receiving water, as well as other considerations (TSD, 1991).

As part of the Water Treatment Pilot Study for CTP Upgrade and Expansion, the EPA conducted aquatic toxicity testing using flathead minnow (*Pimephales promelas)* and water flea (*Ceriodaphnia dubia*). Toxicity testing was conducted using only those two test species because a review of NPDES permits in the area showed that those were the only species being monitored (e.g., permits for Page WWTP, Hecla Lucky Friday Mine, U.S. Silver Coeur and Galena Mines and Mills, and Hecla Grouse Creek Unit; the permits for the Smelterville and Mullan WWTPs do not require any WET testing). Bioassay testing conducted with untreated effluent showed no acute or chronic toxicity in *P. promelas*. This test organism was less sensitive to treated Bunker Hill Site water than the *C. dubia*, so it was omitted from further testing.

Pilot testing was conducted using three separate, continuous-flow, pilot plants operating concurrently and used authentic mining-influenced waters collected from the Site, including Bunker Hill Mine water and metals-contaminated groundwater. The pilot plants treated different influent waters representing water qualities that the upgraded and expanded CTP might receive in the future as different OU 2 and OU3 water collection and conveyance systems are constructed and brought online. Waters collected in OU2 and OU3 in the future will be treated in conjunction with Bunker Hill Mine water, which is currently the predominant influent to the CTP. The pilot systems were operated in a series of testing trials, with each trial representing a different set of operating conditions.

Unfiltered effluent samples from the first trial of the study (Phase 1, Phase 1.5, and Phase 2 Base Flow waters, Trial 1A) exhibited both acute and chronic toxicity in *C. dubia* tests. Since these samples were chronically toxic at dilution levels that were expected to be non-toxic based on the dissolved metals concentrations and TDS in those dilutions, it was hypothesized that the observed toxicity might have been due, at least in part, to resolubilization of particulate metals in the samples when pH was lowered by the bioassay lab to meet the requirements of the toxicity test. (It should be noted that the pilot study did not include filtration of thickener effluent, and therefore the pilot effluent samples used in bioassay testing contained considerably higher TSS concentrations that would occur in a full-scale treatment plant with filters.) To test this hypothesis, the next set of bioassay samples was filtered to remove suspended solids before any reduction in pH occurred in the lab. This and subsequent sets of filtered samples, representing base flow water quality, were essentially non-toxic, thereby providing support for the hypothesis.

The numbers used in the equation below are presented as an example, illustrating the calculation for the <10 percentile WET trigger value.

Wet Trigger Value Calculation as function of Flow

$$C_e = \frac{C_d Q_d - C_u Q_u}{Q_e} = \frac{(1 \text{ x } ((52.16 \text{ x } 0.25) + 9.33)) - (0 \text{ x } 52.16 \text{ x } 0.25)}{9.33} = 2.4 \text{ TU}_c$$

Where

C_d = criterion not to be exceeded in downstream in the receiving water (i.e., at the edge of the mixing zone) = 1 TU_c

Q_d = receiving water flow downstream of the effluent discharge = $Q_u + Q_e$

C_e = allowable effluent concentration at end-of-pipe

Q_e = maximum effluent flow = 6.03 mgd = 9.33 cfs

C_u = upstream concentration of pollutant = 0 (no data available, assumed to be non-toxic)

Q_u = upstream flow = See Table 11. (Note: only 25% of the upstream flow is allowed to blend with the effluent in the mixing zone.)

0 MZ = 25% =0.25

Table 11: Wet Trigger Values for Flow Tiers

Parameter	Flow Tier (percentile of upstream flow in SFCDR at Elizabeth Park)	Flow Tier (cfs)	Q_u (cfs)	WET Trigger Value (TU_c)
Whole Effluent Toxicity (WET)	< 10th	< 71 cfs	52.16 (chronic)	2.4
	10th to < 50th	71 to < 165 cfs	71	2.9
	50th to < Halfway between the 50th and 90th percentiles	165 to < 508 cfs	165	5.4
	Halfway between the 50th and 90th percentiles to < 90th	508 to < 851 cfs	508	14.6
	> 90th	> 851 cfs	851	23.8

TU_c = Chronic Toxic Units

Reference:

CH2M HILL. 2013. *Water Treatment Pilot Study for CTP Upgrade and Expansion, Bunker Hill Mining and Metallurgical Complex Superfund Site*. Technical Memorandum prepared for U.S. EPA Region 10, November 12, 2013.

C. Calculate Waste Load Allocation and Derive Maximum Daily and Average Monthly Effluent Limits

Wasteload allocations (WLAs) are calculated using the same mass balance equations used to calculate the concentration of the pollutant at the edge of the mixing zone in the reasonable potential analysis (See equations A-6 and A-7). To calculate the wasteload allocations, C_d is set equal to the acute or chronic criterion and the equation is solved for C_e. The calculated C_e is the acute or chronic WLA. Equation A-6 is rearranged to solve for the WLA, becoming:

$$C_e = WLA = DF \times (C_d - C_u) + C_u \qquad \text{(Equation C-1)}$$

Idaho's water quality criteria for some metals are expressed as the dissolved fraction, but the federal regulation at 40 CFR 122.45(c) requires that effluent limits be expressed as total recoverable metal. Therefore, EPA must calculate a wasteload allocation in total recoverable metal that will be protective of the dissolved criterion. This is accomplished by dividing the WLA expressed as dissolved by the criteria translator (CT), as shown in equation C-2.

$$C_e = WLA = \frac{DF \times (C_d - C_u) + C_u}{CT} \qquad \text{(Equation C-2)}$$

Or, if no mixing zone is allowed, for metals with criteria expressed as the dissolved fraction:

$$C_e = WLA = C_d/CT \qquad \text{(Equation C-3)}$$

The next step is to compute the “long term average” concentrations which will be protective of the WLAs. This is done using the following equations from Section 5.4.1 of EPA’s *Technical Support Document for Water Quality-based Toxics Control* (TSD):

$LTA_a = WLA_a \times \exp(0.5\alpha^2 - z\alpha)$ (Equation C-4)

$LTA_c = WLA_c \times \exp(0.5\alpha_4^2 - z\alpha_4)$ (Equation C-5)

where,

$\alpha^2 = \ln(CV^2 + 1)$

$\alpha = \sqrt{\ }$

$\alpha_4^2 = \ln(CV^2/4 + 1)$

$\alpha = \sqrt{\ }$

$z = 2.326$ for 99th percentile probability basis

The LTAs are compared and the more stringent is used to develop the daily maximum and monthly average limits that are shown in Table 12, below.

Using the equations from Section 5.4.1 of the TSD, the MDL and AML effluent limits are calculated as follows:

$MDL = LTA \times \exp(z_m\alpha - 0.5\alpha^2)$ (Equation C-6)

$AML = LTA \times \exp(z_a\alpha_n - 0.5\alpha_n^2)$ (Equation C-7)

where α, and α^2 are defined as they are for the LTA equations (C-2 and C-3) and,

$\alpha_n^2 = \ln(CV^2/n + 1)$

$\alpha = \sqrt{\ }$

$z_a = 1.645$ for 95th percentile probability basis

$z_m = 2.326$ for 99th percentile probability basis

n = number of sampling events required per month (minimum of 4)

Future effluent discharge limits calculated and established for the upgraded CTP are compared to current effluent discharge limits in Table 12.

Table 12: Current and Future Effluent Limits for CTP discharge at Outfall to SFCDR				
Parameter and Units	**Future Effluent Discharge Limits**		**Current Effluent Discharge Limits**[d]	
	Average Monthly Limit[e]	Maximum Daily Limit[f]	Average Monthly Limit[e]	Maximum Daily Limit[f]
Cadmium, total recoverable (TR), µg/L	2.76	5.53	50	100
Copper, TR, µg/L	57[a]	115[a]	150	300
Lead, TR, µg/L	16[a]	32[a]	300	600
Mercury, total, µg/L	0.022[b]	0.045[b]	1.0	2.0
pH, standard units	6.5 – 10.0		6.0 – 10.0	
TSS, mg/L	20	30	20	30
TSS - WLA[c]	56.1 tons/year		--	
Zinc, TR, µg/L	244	489	730	1,480
WET, chronic, TU_c	See Table 11		--	

[a] Discharge of neither copper nor lead has a reasonable potential to cause or contribute to excursions above their respective water quality standards, based on the effluent data. Per EPA direction, water quality-based limits were calculated and established for lead and copper, because a discharge at the technology-based limits would cause violations of water quality criteria.

[b] Based on EPA chronic aquatic life water column criterion for total recoverable mercury of 0.012 µg/L.

c In order to meet the substantive requirements of the Idaho TMDL for the SFCDR Subbasin, the annual average waste load allocation (WLA) for TSS for the CTP will be 56.1 tons/year (South Fork Coeur d'Alene River Sediment Subbasin Assessment and Total Maximum Daily Load, IDEQ, 2002).

d The CTP currently operates to meet the discharge limits that were established in the NPDES permit that became effective in 1986 (Permit No. ID 000007-8).

[e] Sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month. Referred to as Daily average limit in the 1986 permit.

[f] Highest allowable daily discharge.

V. Monitoring

A. Basis for Effluent and Surface Water Monitoring

Section 308 of the CWA and federal regulation 40 CFR 122.44(i) require monitoring in permits to determine compliance with effluent limitations. Monitoring may also be required to gather effluent and surface water data to determine if additional effluent limitations are required and/or to monitor effluent impacts on receiving water quality. Operation and maintenance contractors will be required to perform monitoring and ensure appropriate record keeping.

B. Effluent Monitoring

Monitoring frequencies are based on the nature and effect of the pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. More frequent samples can be taken and used for averaging if they are conducted using EPA-approved test methods (generally found in 40 CFR 136) and if the Method Detection Limits are less than the effluent limits.

Table 13 presents the effluent monitoring that will occur at the CTP. The sampling location must be after the last treatment unit and prior to discharge to the receiving water. If no discharge occurs during the reporting period, "no discharge" shall be documented.

Phosphorous

Phosphorus is not a constituent of concern identified in the RODs for the Bunker Hill Site, nor is mine water considered to be a source of phosphorus. Therefore, phosphorus was not evaluated in the Pilot Study to support the current planned upgrades to the CTP. The Groundwater Collection System (GWCS) to be constructed between the Central Impoundment Area (CIA) and the SFCDR will be designed to intercept and collect contaminated groundwater flowing under the CIA. Groundwater emanating from beneath the CIA does contain concentrations of total phosphorus (Total-P) that are measurably elevated relative to background conditions in surface water. The mean and median concentrations for nine groundwater monitoring wells bordering the CIA from 2008 to 2014 are 1.99 mg/L and 1.20 mg/L, respectively. This groundwater currently discharges to the SFCDR in a gaining reach of the river adjacent to the CIA, so this phosphorus loading is currently contributing to phosphorus levels in the SFCDR. SFCDR monitoring data show that surface water stream flow-weighted concentrations of Total-P increase below the CIA, and again below the Page and Smelterville WWTP outfalls (USGS, 2014).

The primary purpose of the GWCS is to capture metals before they enter the river, but it is expected to have the same effect for phosphorus in the groundwater. The collected groundwater will be conveyed to the CTP for treatment. The CTP is designed to remove metals via hydroxide precipitation using lime. There is the potential for the CTP to remove some of the phosphorus from the influent water through precipitation; the CTP influent water contains iron and aluminum and the main treatment reagent is lime, all of which could result in precipitation of phosphorus. A rough estimate of the future amount of phosphorus in CTP influent and effluent (after the GWCS and CTP upgrades are constructed) can be calculated as shown below. With some removal assumed, it is likely that concentrations discharged to the SFCDR will be less than 1 mg/L. Phosphorus monitoring will not be required as part of the CTP upgrades and operational monitoring as part of that contract.

Estimated Phosphorus in Future CTP Influent and Effluent

Parameter	CTP Influent			CTP Effluent		
	Mine water	GWCS	Total	No removal	50% removal	90% removal
Flow, gpm	1,300	2,000	3,300	3,300	3,300	3,300
Total-P conc, mg/L	0	1.99	1.20	1.20	0.60	0.12
Total-P load, lb/d	0	47.8	47.8	47.8	23.9	4.78

Table 13: Effluent Monitoring Frequency – CTP			
Parameter	**Unit**	**Sample Frequency**	**Sample Type**
Effluent Flow	mgd	Continuous	Recording
Acute Whole Effluent Toxicity	TU_a	Quarterly	24 hr. composite
Cadmium, TR	µg/L	Weekly	24 hr. composite
Chronic Whole Effluent Toxicity	TU_c	Monthly	Grab
Copper, TR	µg/L	Weekly	24 hr. composite
Hardness	mg/L as $CaCO_3$	Weekly	Grab
Lead, TR	µg/L	Weekly	24 hr. composite
Mercury, total	µg/L	Weekly	24 hr. composite
pH	s.u.	Continuous	Recording
Dissolved Oxygen	mg/L	Weekly	Grab
Temperature	ºC	Weekly	Grab
Turbidity	NTU	Continuous	Recording
Total Suspended Solids	µg/L	Weekly	24 hr. composite
Zinc, TR	µg/L	Weekly	24 hr. composite

VI. Biological Evaluation

Section 7 of the Endangered Species Act (ESA) requires federal agencies to consult with the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) and the U. S. Fish and Wildlife Service (USFWS) if their actions could beneficially or adversely affect any threatened or endangered species and/or their critical habitat. EPA has reviewed the ESA-listed species and critical habitat data on each of the agency's websites. There are no ESA-listed species or critical habitat in the vicinity of the discharge. EPA determined that the discharge requirements for the CTP for discharges of treated mine influenced water and groundwater to the South Fork Coeur d'Alene River will have "no effect" on any of the threatened or endangered species or their critical habitat in the vicinity of the discharges.

The information below summarizes the threatened and endangered species in the State of Idaho and in the vicinity of the discharges.

Threatened and Endangered Species in Idaho are available on the USFWS website at http://www.fws.gov/endangered/

For Shoshone County, Idaho

Group	Name	Population	Status	Lead Office	Recovery Plan Name	Recovery Plan Action Status	Recovery Plan Stage
Fishes	Bull Trout (*Salvelinus confluentus*)	U.S.A., conterminous, lower 48 states	Threatened	Idaho Fish And Wildlife Office Office Name: Idaho Fish And Wildlife Office Address: 1387 SOUTH VINNELL WAY, SUITE 368 BOISE, ID83709 Phone Number: (208)378-5243	Draft Recovery Plan for the Jarbidge River Distinct Population Segment of Bull Trout	View Implementation Progress	Draft
Mammals	Canada Lynx (*Lynx canadensis*)	(Contiguous U.S. DPS)	Threatened	Montana Ecological Services Field Office Office Name: Montana Ecological Services Field Office Address: 585 Shepard Way HELENA, MT59601 Phone Number: (406)449-5225	Recovery Outline for the Contiguous United States Distinct Population Segment of Canada Lynx (Lynx canadensis)	Recovery efforts in progress, but no implementation information yet to display.	Outline

U.S Fish & Wildlife Service shows no designated critical habitat information where the CTP discharges. http://criticalhabitat.fws.gov/crithab/. Critical habitat shown in yellow.

Figure 3. USFWS Critical Habitat Designations near CTP outfall